NON-PUBLIC?: N
ACCESSION #: 9205040001
LICENSEE EVENT REPORT (LER)

FACILITY NAME: CRYSTAL RIVER UNIT 3 PAGE: 1 OF 05

DOCKET NUMBER: 05000302

TITLE: Relay Design Combined with Maintenance Trouble Shooting Leads to
De-energized ES Busses, Reactor Trip, and Emergency Diesel
Generator Start
EVENT DATE: 03/27/92 LER #: 91-001-00 REPORT DATE: 04/27/92

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 098

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: W. A. STEPHENSON, NUCLEAR SAFETY TELEPHONE: (904) 795-6486
SUPERVISOR

COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On March 27, 1992, Crystal River Unit 3 was operating in MODE 1 at 98% Rated Thermal Power. Maintenance was in progress on the 'C' Vital Bus inverter. The inverter was malfunctioning and troubleshooting was in progress to determine the root cause of the problem. Leads had been lifted to partially isolate a constant voltage transformer internal to the inverter. At 1308, with the inverter output iso
ated, it was
connected to the DC system input. This imposed a 350 volt peak-to-peak AC feedback signal on the DC system. This caused two relays which receive control power from the DC system to actuate, opening the feeder breakers and isolating the 230 KV Offsite Power Transformer. This de-energized the 4160 volt Engineered Safeguards (ES) busses, causing a reactor trip and an Emergency Diesel Generator start. A four hour report

was made as required by 10CFR50.72(b)(2)(ii). This event is reportable under 10 CFR 50.73(a)(2)(iv). The relays, which are used for normal operation of the transformer feeder breakers and do not perform any protective relaying function, were disabled prior to restart to preclude future spurious trips.

END OF ABSTRACT

EVENT DESCRIPTION

On March 27, 1992, Crystal River Unit 3 was operating in MODE 1 at 98% Rated Thermal Power. Maintenance was in progress on the 'C' Vital Bus inverter EE,INVT!. The inverter had malfunctioned as evidenced by blown fuses, and troubleshooting was in progress to determine the root cause of the problem.

A planned test configuration required that the Constant Voltage Transformer EE,XFMR!, (General Electric model number 9T91Y7244) within the inverter, be isolated by lifting the transformer leads. The inverter was then to be repowered by connection to the DC power supply EE,UJX! by closing the DC input breaker. The inverter output remained isolated with the output breakers open. In the process of isolating the transformer, the electricians had only lifted one lead. While this did take it out of the circuit, it did not isolate the transformer. When the DC input breaker was closed, at 1308 pm, a 350 volt peak-to-peak square wave was superimposed on the DC system with respect to ground.

When the AC signal was imposed onto the DC voltage, the Offsite Power Transformer (OPT) EL,XFMR! feeder breaker EL,BKR! remote opening relays EL,RLY! began to chatter. The chattering almost immediately picked up the contacts for the relay, sending an "OPEN" command to both breakers feeding the OPT. Both breakers opened, isolating the OPT from the 230 KV switchyard. This removed power from both Engineered Safeguards (ES) 4160 volt busses JE,BU!, as their normal alignment is to the OPT.

Both Emergency Diesel Generators (EDG), EK,DG! started on bus undervoltage and powered their associated ES bus. The loss of ES 4160 volt bus power also de-energized the Control Rod Drive (CRD) motors AA,MO! causing the rods to fully insert.

When the ES busses lost power, the normal control room overhead lights LF! extinguished. The reactor operator looked at the reactor control panel, saw all the rods indicating fully inserted (the "rod full in" lights AA,IL! were illuminated), announced a reactor trip and began the immediate actions of the reactor trip procedure. As required by procedure, the operator depressed the manual reactor trip pushbutton JC,HS! which activated the "reactor trip confirmed" electronics, opened all the CRD breakers and tripped the turbine SB,TRB!. At the time the turbine tripped, the Reactor Coolant System (RCS) pressure had decreased and approached the low pressure trip setpoint. The other licensed operator in the control room noted that pressurizer AB,PZR! level had decreased and that no Make Up Pump (MUP) CB,P! was running due to the initial loss of power. The operator manually started a MUP to control RCS inventory. The immediate post trip RCS temperature was somewhat lower than the expected post trip envelope; but timely operator response prevented this event from being classified as an "overcooling transient".

The reactor was stabilized in MODE 3, Hot Standby. The OPT was checked, re-powered, and the ES busses returned to normal alignment. The Diesel Generators were secured. The plant was cooled down to MODE 5 for maintenance work on control rod position indication prior to post-trip restart. A four hour report was made as required by 10CFR50.72(b)(2)(ii). This event is reportable under 10 CFR 50.73(a)(2)(iv).

CAUSE:

The root cause of this event was relay design combined with the specific off-normal alignment of equipment utilized in the troubleshooting effort. Failed components in the inverter may have additionally contributed to the event.

The emergency power scheme for Crystal River 3 incorporates several levels of power sources, one of these being four uninterruptible power supplies (UPS) EE,UJX! called the Vital Busses. Each 120 volt AC bus is powered from two sources, the preferred being the Vital Bus Static Inverter EE,INVT! (a dual input inverter), and the alternate source being the 480 volt ES bus via a dedicated voltage regulating transformer which bypasses the inverter.

The inverter normally rectifies 480 volt ES AC power to DC power. The inverter then inverts the DC power back to 120 volt AC power, through a constant voltage transformer EE,XFMR! within the inverter, which supplies the load. If the AC power input is lost, the inverter will instantly draw power from banks of lead-acid batteries EE,BTRY! providing DC power and invert that to 120 volt AC power for the Vital busses.

At the beginning of this event, the 'C' Vital bus was being supplied from the alternate source, the 480 volt ES bus and voltage regulating transformer, because the normal source, the inverter, was out of service for maintenance. Under the troubleshooting package, several test configurations were to be established in the inverter to locate the root cause of the problem. A test configuration required that the Constant Voltage Transformer EE,XFMR!, within the inverter, be isolated by lifting the transformer leads. The inverter was then to be connected to the DC power input by closing the DC input breaker. In the process of isolating the transformer, the electricians had only lifted one lead. While this did take it out of the circuit, it did not isolate the transformer. When the DC input breaker was closed, the partially isolated transformer induced an AC voltage (350 volts peak-to-peak) onto the DC bus. The only apparent effect was the tripping of the interposing relays used for normal OPT feeder breaker control.

Later testing showed a unique sensitivity in these relays, not shared generically throughout the DC power system. The relay actuation isolated the transformer and de-powered both ES 4160 volt busses. The loss of ES bus power caused the EDGs to start.

EVENT EVALUATION:

There were four main consequences of the loss of ES busses: first, both EDGs started on a valid undervoltage signal on the ES 4160 volt busses. Second, the motor driven Emergency Feedwater Pump (EFWP) auto started on ES bus undervoltage and EDG output breaker closure. Third, there was no power to the 'C' Vital Bus because it was normally aligned to the "A" ES 4160 volt bus/"A" ES 480 volt bus. Fourth, due to electrical alignment and effected busses, there was no power to the CRD motors and all control rods inserted on loss of power. Each of these consequences is discussed below.

The loss of power to the ES 4160 volt busses is accounted for in the design of the plant. Should power be lost to the busses, the EDGs auto start, come to synchronous speed and automatically power the ES bus loads. This action occurred as expected. The EDGs carried the ES 4160 bus loads until 1538 for the "B" EDG and until 1918 for the "A" EDG. The only anomaly in EDG performance was a leak in the jacket cooling system for the 'B' diesel.

The EFWP auto started, though there was no Emergency Feedwater Initiation and Control (EFIC) system actuation. This is as designed. Whenever there is an undervoltage on the ES 4160 volt busses followed by an EDG output breaker closure, the motor driven EFP (EFP-1) auto starts as the bus is block loaded by the EDG. The EFIC system and EFP-1 both worked as designed and expected.

The 'C' vital bus was deenergized because it was being fed by the ES 4160 volt bus/ES 480 volt bus. This bus powers the 'C' Channel of the Reactor Protection System (RPS). When the power to the system fails, the channel trips. In addition to the RPS, channel "C", the "C" Vital Bus also powers the Recall system, a passive data recording system, and an annunciator events recorder. The loss of power caused a loss of some transient information normally used to analyze an event.

The CRD motors lost power and all the control rods inserted into the core. The CRD motors are designed so that a sectioned roller nut engages a lead screw on the control rod. The roller nut sections are designed to be disengaged from the lead screw by springs. The roller nut is held in the engaged position by electromagnetic force. The roller nut is turned by progressing the electromagnetic field around the control rod (moving in discrete steps), turning the roller nuts around the lead screw, raising and lowering the rod in the core. When power was lost to the CRD motors, the roller nuts disengaged and the rods inserted.

CORRECTIVE ACTIONS:

There were several corrective actions taken to preclude recurrence of this event. Prior to plant restart, the relays that send the remote open signal to the feeder breakers for the OPT were disabled. These relays provided no protective relaying functions so there is no loss of equipment protection. The feeder breakers can now be manually opened with control switches installed. in the 230 KV switchyard prior to startup. A second action to monitor the DC bus for noise prior to reduced RCS inventory operations will be implemented during the upcoming refueling outage. Lastly, a human performance review will be conducted on the inverter troubleshooting evolution to determine if the risks should have been known or anticipated. The first action is already completed, the others are scheduled for completion by July 1, 1992.

PREVIOUS SIMILAR OCCURRENCES:

A similar actuation of these relays occurred during the mid-cycle 8 maintenance outage. See LER 91-10 for details of that event.

ATTACHMENT 1 TO 9205040001 PAGE 1 OF 1

Florida
Power
CORPORATION

Crystal River Unit 3
Docket No. 50-302

April 27, 1992
3F0492-12

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Subject: Licensee Event Report (LER)
92-01

Dear Sir:

Enclosed is Licensee Event Report (LER) 92-01 which is submitted in accordance with 10 CFR 50.73.

Sincerely,

G. L. Boldt
Vice President
Nuclear Production

EEF:mag

Enclosure

xc: Regional Administrator, Region II
Project Manager, NRR
Senior Resident Inspector

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